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Laboratory Exercises in General Science. By HERBERT BROWNELL. New York: Macmillan, 1916. Pp. 215. $0.80.

General Science. By LEWIS ELHUFF. New York: D. C. Heath & Co., 1916. Pp. 433. $1.20.

A First Year in Science. By ADA L. WECKEL and JOSEPH L. THALMAN. Chicago: Row, Peterson & Co., 1916. Pp. 441. $1.25.

At the present time a discussion of courses in general science needs to deal chiefly with the nature of the content, basis of organization, type of unity of the course, and plans for experimentation and observation by the pupils. These points will be chiefly considered in this review. The books contain numerous things which would make it easily possible to construct a review which would deal with style, accuracy or facts, etc., but since the points mentioned in the first sentence are fundamental and are less frequently considered, they are the ones to which attention is here directed.

In the development of courses in general science it is recognized that the experimental side of the work is a matter of great importance. In the first of these three books the author has attempted to present directions for pupil experiment and for teacher demonstrations, with the intent that these outlines shall constitute the basis of the course. It is recommended that the accompanying reading-assignments be selected from numerous texts which are to be made available to the pupils, but no single text be depended upon for the major part of the assignments. In order to make such reading effective there is an appendix of recommended books, and an accompanying list of definite page citations for each of the sixteen general headings under which the laboratory exercises are grouped.

The basis for selection of materials and plans for unifying general science are indicated in the statement that the body of knowledge to be presented in the course is that which "appeals to beginners and finds its unity in their life-experiences and interests." It is frankly recognized by the author that there are many common facts of science which must be omitted from a course in general science, because they may not be of great significance, and because they may not be made a part of the unified scheme; and unity is essential if the course is to have the coherence necessary to true science teaching. The pupil's social and intellectual interests and needs are the guiding principle in selection and organization, rather than the need for the inclusion either of many common trivial details of scientific facts, or for the representation of each of the differentiated sciences.

Based upon the principles above stated, the author's sixteen major topics are of interest as showing the kinds of materials which he regards as essential to the course. They are: "The Human Body," "Heat in Relation to the Human Body," "Health and Well-Being," "Matter and Force," "Water and Its Uses," "The Atmosphere," "Weather and Climate," "At Our Homes," "Household Chemistry," "The Home Surroundings," "Local Industries," "The Farm and Our Food Supplies," "Work and Machines," "Magnetism and Electricity," "Phenomena of Light," "The Earth as a Planet," and "The Heavens." Each of these major topics is subdivided into a series of exercises which progress readily and consecutively. Each consists of a series of problems and questions upon the subject in hand. Ninety illustrations, diagrams, and tables are presented to make the experiments, demonstrations, problems, and questions specific. No space is provided for student notes and sketches, an additional notebook being required for that purpose.

In Elhuff's *General Science*, it is stated that the course is organized about "two or three basic ideas which have a broad application and which the mass of simple facts helps to develop into clear concepts. These basic ideas are matter, its properties, and how matter affects other matter—the reaction of matter upon matter; and energy as a property of matter." As is implied by this prefatory statement, this course deals chiefly with physics and chemistry, although there is material which deals with hygiene, plant life, and household applications of science. As an illustration of the attempt to give representation to the different sciences we may cite two chapters. The one given to zoölogy, chap. xl, consisting of 15 pages, on "The Animal Series," deals with protozoa, worms, insects, crayfish, amphibians, reptiles, birds, and mammals; and the chapter on "Astronomy," chap. xlii, in 7 pages, deals with the earth, sun, moon, planets, stars, and meteors.

The text material is presented in descriptive form, not by discussion of vital problems. The questions at the close of the chapters are in the nature of review questions on the text statements, not problems which require constructive thought. The illustrations in the text are not numbered and are not cited in the text discussions; consequently cannot be so truly an organic part of the presentation of the topics as when citation is made at the point where the illustration is pertinent. Furthermore, some of the illustrations are redrawn from well-known and previously published works but are not credited to those who first prepared these illustrations. No laboratory work is provided, and no statement is given to show what experimental or observational work is expected in connection with the course.

Weckel and Thalman's *A First Year in Science* attempts to provide "a year in physics, chemistry, botany, zoölogy, physiology, and physiography." This text, and the laboratory manual in general science by the same authors, are the outcome of several years of experimentation in teaching first-year science. The purposes they express—to train the pupil "to observe more accurately, to interpret more sanely, to understand the vital importance of everyday affairs, to apply acquired knowledge to useful ends, to become a better citizen of his community," are the purposes held by all progressive teachers of first-year science.

The organization of this text is essentially that of a series of short courses in the special sciences, as is shown by an investigation of the chapter headings and the detailed material within these chapters. Thus chaps. i to vi deal respectively with "Matter," "Constitution of Matter," "Effect of Heat on Matter," "Transfer of Heat," "Measurement of Temperature," "Changes in State of Matter." Chap. vii deals with "Physical and Chemical Changes," and then chaps. viii to xvi deal similarly with strictly chemical topics, chiefly with the chemistry of the elements; chaps. xvii to xxiv deal with physiography; chaps. xxv to xxx, with botany; chaps. xxxi to xxxv, with zoölogy, and chaps. xxxvi to xl, with human physiology. The materials presented and the form of presentation are quite similar to the materials and presentation of the differentiated sciences as they appear in separate texts on the different subjects. At the close of each chapter there are review questions, not problems, these being designed to elicit restatement of the specific information given previously in the chapters.

There is a wide difference in the points of view shown in the organization of these three courses. In a truly general science course, such as that outlined by Brownell, significant topics in science are selected and studied by use of materials, methods, and thought which may come from any special science as needed. No attention is given to an effort to have each special science "represented," but the topic is studied so as to develop productive thought about it in its relations to the pupil's life and experiences. Coherence and progression in the course is secured by using the inherent vital relations which enable the pupil to pass logically and psychologically from one study to another. Trivial details are avoided on the one hand, and on the other there is avoidance of the appearance of an attempt to present a course in each of the special sciences in a one-year program.

Two serious pitfalls endanger an attempt to teach an introductory course by use of brief courses in each of the special sciences. The first and most serious danger is that pupils are not directed to take up common problems with a scientific method of inquiry, using all the science that can be called upon in the study of these problems, but rather are led to try to apply their classified knowledge of botany, physics, etc., to the problem. The second danger—a danger to the pupil in that he gets a false idea of his attainments and a danger to further work in science—is that the pupils gain the notion that they have had the special sciences, and do not need to take more work in them. Science teaching, to be most helpful in the daily lives and in the later scientific training of high-school pupils, needs to avoid both of these dangers. There can be no doubt on the part of anyone who seriously and calmly studies the situation, that the differentiated sciences have made great gain in their usefulness in secondary education. We should save all this gain, and if we allow brief courses to give the impression that pupils do not need further work in separate sciences there will be great loss; but the immediate difficulty is that special sciences in the first year do not give the kind of training that general science has demonstrated its ability to give.

O. W. C.